Fact Sheet

NPDES Permit Number: **AK-0052779**
Date:
Public Notice Expiration Date:

Technical Contact: **Mike Lidgard (206) 553-1755 or**
1-800-424-4372 (within Region 10) or
lidgard.michael@epa.gov

The U.S. Environmental Protection Agency (EPA)
Proposes to Issue a Modification to a
Wastewater Discharge Permit to:

BP Exploration, Alaska -
(Northstar Development Project)
900 E Benson Boulevard
Anchorage, Alaska 99508

and
the State of Alaska proposes to Certify the Permit Modification

EPA Proposes NPDES Permit Modification

EPA proposes to modify a National Pollutant Discharge Elimination System (NPDES) permit to BP Exploration, Alaska, Northstar Development Project. The draft permit modification sets conditions on the discharge of pollutants from the facility located at Seal Island in Stefansson Sound, in the Beaufort Seas, Alaska. In order to ensure protection of water quality and human health, the permit places limits on the types and amounts of pollutants that can be discharged.

This fact sheet includes:

- information on public comment, public hearing, and appeal procedures
- a description of the proposed discharge
- a listing of past and proposed modified effluent limitations and other conditions
- detailed background information supporting the conditions in the draft permit

The State of Alaska Proposes Certification

The Alaska Department of Environmental Conservation (ADEC) proposes to certify the

NPDES permit modification for BP Exploration, Alaska, Northstar Development Project, under section 401 of the Clean Water Act. EPA may not issue the final NPDES permit until the state has granted, denied, or waived certification.

State of Alaska Consistency Determination

The State of Alaska, Office of Management and Budget, Division of Governmental Coordination (DGC), will review this action for consistency as provided in Section 307(c)(3) of the Coastal Zone Management Act of 1972, as amended [16 U.S.C. 1456(c)(3)]. The consistency certification is a statement of assurance that this federally permitted activity, which will affect the coastal zone, will be conducted in a manner consistent with the enforceable policies and standards of the Alaska Coastal Management Program.

Public Comment

Persons wishing to comment on or request a public hearing for the draft permit modification may do so in writing by the expiration date of the Public Notice. All comments or requests for a public hearing should include the name, address and telephone number of the commenter and a concise statement of the exact basis of any comment and the relevant facts upon which it is based. All comments and requests for a public hearing must be in writing and should be submitted to EPA as described in the Public Comments Section of the attached Public Notice.

If no substantive comments are received, the tentative conditions in the draft permit modification will become final, and the permit modification will become effective upon issuance. If comments are received, EPA will address the comments and issue the permit modification. The permit modification will become effective 33 days after the issuance date, unless a request for an evidentiary hearing is submitted within 33 days.

Persons wishing to comment on State Certification should submit written comments before the public notice expiration date to the Alaska Department of Environmental Conservation at this address:

Alaska Department of Environmental Conservation
Southcentral Office
555 Cordova Street, 3rd floor
Anchorage, Alaska 99501

Documents are Available for Review

The draft NPDES permit modification and related documents can be reviewed or obtained by visiting or contacting EPA's Regional Office in Seattle between 8:30 a.m. and 4:00 p.m., Monday through Friday (See address below).

Region 10
1200 Sixth Avenue, OW-130
Seattle, Washington 98101
(206) 553-0523 or
1-800-424-4372 (within Alaska, Idaho, Oregon and Washington)

The fact sheet and draft permit modification are also available at:

EPA Alaska Operations Office, Room 537
Federal Bldg.
222 W. 7th Avenue, #19
Anchorage, Alaska 99513-7588

EPA Alaska Operations Office
410 Willoughby Avenue
Juneau, Alaska 9980-1795

For technical questions regarding the permit or fact sheet, contact Mike Lidgard at the phone numbers or email address at the top of this fact sheet. Those with impaired hearing or speech may contact a TDD operator at 1-800-833-6384. Ask to be connected to Mike Lidgard at the above phone numbers. Additional services can be made available to persons with disabilities by contacting Mike Lidgard.

The draft permit and fact sheet can also be found by visiting the Region 10 web site at www.epa.gov/r10earth/water.htm.

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Background Information

I. Introduction

A. Project Background

BP Exploration (Alaska), Inc. (BPXA) received approval in May 1999 for the construction and operations of the Northstar Development Project as described in the Department of the Army (Corps) permit N-950372, Beaufort Sea 441. In conjunction with the Corps permit, BPXA received an individual NPDES Permit (AK-0052779) issued by the U.S. Environmental Protection Agency (EPA) as authorized by provisions in the Clean Water Act. The NPDES permit became effective on June 23, 1999.

BPXA's proposed action for the Northstar Unit is a self-contained offshore development/production facility located on a gravel island in approximately 39 ft of water roughly 6 miles offshore of Point Storkersen in the Alaskan Beaufort Sea. The gravel island would be constructed over the remains of Seal Island, an island built by Shell Oil Company to conduct exploratory activities within the Northstar Unit during the 1980's.

The NPDES Permit issued by EPA authorized the following discharges:

- Outfall 001(a) - Continuous flush system,
- Outfall 001(b) - Brine effluent associated with the potable water system (vapor compression distillation),
- Outfall 001(c) - Effluent from the domestic wastewater treatment system (temporary discharge during periods when the Class I injection well is not available),
- Outfall 002 - Seawater discharged through fire suppression system during periodic tests,
- Outfall 005 - Construction dewatering (short term during construction).

Outfall 001 consists of up to three commingled streams: continuous flush, brine effluent, and treated domestic wastewater effluent. The continuous flush system is designed to prevent ice formation and biofouling. The desalination brine is a byproduct of the potable water system which renders freshwater from seawater, The freshwater produced is utilized for both human and operational activities. Domestic wastewater, following an activated sludge and ultraviolet (UV) treatment, may also occasionally be commingled with these discharge streams; this particular stream results almost exclusively from human activities related to food preparation, consumption, and bathing, and does not contain any fluids related to the oil production/processing systems. As noted above, collectively these three streams are referred to as Outfall 001.

B. Overview of Proposed Modification.

Current estimates for freshwater use on Seal Island have risen from the rates evaluated in the NPDES Fact Sheet and presented in the *Final Environmental Impact Statement Beaufort Sea Oil and Gas Development/Northstar Project* (Corps, 1999). Thus, BPXA has requested a modification to the NPDES permit (AK-0052779) for an increase in the desalination capacity (freshwater production). This will result in an increase in flow through Outfall 001b. It is anticipated that freshwater used on the island will be processed through the sanitary and domestic wastewater system or discharged through the underground injection well, as available. Therefore, an incremental increase for the sanitary and domestic wastewater discharge, Outfall 001c, is also requested. BPXA requests an increase in flow for outfall 001 only. No change to other limitations for outfall 001 is requested.

The proposed modifications to the Northstar NPDES Permit are limited to Outfall 001. The proposed permit modifications do not affect the other permitted discharges–fire suppression system test water (Outfall 002) and construction dewatering (Outfall 005). This Fact Sheet describes the proposed modifications and evaluates the resulting discharges for Outfall 001.

II. Activity Modifications

BPXA proposes to increase the desalination effluent (Outfall 001b) for the production of additional freshwater for use by operations and personnel. The additional freshwater production will result in the incremental increase in flow through the seawater intake sump (feed water) and increase the effluent discharge from the domestic and sanitary wastewater system (Outfall 001c). However, the proposed increase in freshwater production will not result in the installation and use of equipment that was not evaluated in the original Fact Sheet (Corps 1999). Also, the uncontaminated flushwater (Stream 001a) system will not be altered. The following descriptions of each waste stream were taken from the original Fact Sheet (Corps 1999), and include descriptions of the proposed modifications to the desalination effluent (Outfall 001b) and the domestic and sanitary wastewater system (Outfall 001c). Table 1 summarizes the changes in flow rates for each of the Outfall 001 waste streams.

A. Continuous Flush System Effluent – Stream 001a

The Continuous Flush system discharge will flow continuously through Outfall 001 to protect various pipelines and process systems from fouling by aquatic organisms and to eliminate the possibility of ice formation within these lines and process systems. This discharge stream will be ambient seawater taken in through the seawater intake sump (SWIS) and pumped directly through Outfall 001 with minimal winter-time heating. As seawater enters the SWIS, it is expected that

warm water recirculation during the ice-covered winter season will raise the water temperature up to 0.5°F (0.3°C) above ambient, and process equipment will raise the water temperatures an additional 1.3°F (0.7°C) throughout the year. These temperature increases were described in the *Final NPDES Permit Application* (BPXA 1997). This stream will be chlorinated to prevent biofouling, then dechlorinated with the other wastestreams associated with Outfall 001 prior to discharge.

There will be no changes to this wastestream as a result of this proposed permit modification.

B. Desalination Unit Wastes – Stream 001b

The potable water desalination unit uses vapor compression (thermocompression) technology to generate water suitable for human consumption. Vapor compression desalination is a method of evaporating seawater whereby the energy efficiency is enhanced by compression and recycled to evaporate additional seawater. The desalination process results in a brine effluent with a dissolved solids concentration about twice the ambient water concentration, regardless of the process rate. The manufacturer determined that total dissolved solids would increase to 65 to 70 parts per thousand (ppt) for ambient seawater containing 36ppt. It is expected that the desalination blowdown water (brine) will have a maximum salinity between 60ppt and 65ppt when ambient seawater is between 30ppt and 32.5ppt. The engineering specifications provided by the manufacturer indicate the effluent will have a temperature increase of 5°C to 7°C over ambient conditions.

BPXA proposes to increase the freshwater production capacity resulting in an increase in the desalination effluent flow (Stream 001b) from the current daily maximum flow of 18,060 gallons per day (gpd) to 37,140 gpd. As presented in Table 1, BPXA anticipates the possibility that the daily maximum, weekly average, and monthly average flow rate for the desalination effluent (Stream 001b) could be the same rate during periods of high water use in the early stages of development. The concentration of maintenance chemicals, temperature, and salinity will be the same as reported in the original NPDES Fact Sheet (Corps 1999).

Table 1. Flow rate changes for Outfall 001		
Parameter	Original NPDES Fact Sheet	Proposed Modification
Continuous Flush Waste Stream (001a)		
Daily Maximum Flow (24-hr period)	21,600 gpd	21,600 gpd *(no change to permit)*
Weekly Average Flow (7-day period)	21,600 gpd	21,600 gpd *(no change to permit)*
Monthly Average Flow (30-day period)	21,600 gpd	21,600 gpd *(no change to permit)*
Desalination (Brine) Effluent Waste Stream (001b)		
Daily Maximum Flow (24-hr period)	18,060 gpd	37,140 gpd *(increase of 19,080 gpd)*
Weekly Average Flow (7-day period)	10,795 gpd	37,140 gpd *(increase of 26,345 gpd)*
Monthly Average Flow (30-day period)	3,530 gpd	37,140 gpd *(increase of 33,610 gpd)*
Treated Domestic and Sanitary Wastewater (001c)		
Daily Maximum Flow (24-hr period)	9,360 gpd	14,400 gpd *(increase of 5,040 gpd)*
Weekly Average Flow (7-day period)	6,080 gpd	14,400 gpd *(increase of 8,320 gpd)*
Monthly Average Flow (30-day period)	2,800 gpd	14,400 gpd *(increase of 11,600 gpd)*
Outfall 001 (combined 001a, 001b, & 001c)		
Daily Maximum Flow (24-hr period)	49,020 gpd	73,140 gpd *(increase of 24,120 gpd)*
Weekly Average Flow (7-day period)	Not applicable	Not applicable
Monthly Average Flow (30-day period)	27,930 gpd	73,140 gpd *(increase of 45,210 gpd)*

C. Sanitary and Domestic Wastewater – Stream 001c

The wastewater treatment plant will receive all of the domestic sewage and sanitary waste water generated at the Seal Island production facility. The treatment plant will consist of fixed-media activated-sludge (bacterial) treatment (FAST) system that automatically treats all domestic wastewater. A disinfectant system using ultraviolet (UV) light will be placed in the discharge stream between

secondary treatment and final disposal. Typically, the wastewater stream (Outfall 001c) will be injected into the permitted disposal well. However, during facility construction and periods when the injection well is not available, the wastewater treatment plant effluent will be commingled with the seawater treatment plant backwash, continuous flush, and potable water desalination waste streams. The resulting commingled stream will be dechlorinated via the addition of a sodium metabisulfite solution prior to marine discharge through Outfall 001.

The 5-day biological oxygen demand (BOD5) values provided in the *Final NPDES Permit Application* (BPXA 1997) for discharge through Stream 001c are 25 milligrams per liter (mg/L) maximum daily and 15 mg/L average daily concentrations. The total suspended solids (TSS) values are 34 mg/L maximum daily and 25 mg/L average daily concentration. The BOD5 and TSS concentrations, and temperature values for Outfall 001c will be the same as noted in the original NPDES Fact Sheet (Corps 1999).

BPXA proposes to increase the domestic and sanitary discharge from a daily maximum flow of 9,360 gpd, as currently permitted, to a proposed rate of 14,400 gpd, which is the maximum capacity of the system. As presented in Table 1, BPXA anticipates the possibility that the daily maximum, weekly average, and monthly average flow rate for the domestic and sanitary effluent (Stream 001c) may be the same during periods of high water use in the early stages of development.

D. Proposed Conditions for Outfall 001

The proposed permit modification will result in an increased flow from Outfall 001 as a result of increasing flow in the desalination (Stream 001b) and sanitary and domestic waste (Stream 001c) effluents. Table 2 presents the modified end-of-pipe effluent limitations for Outfall 001. The only changes in the end-of-pipe effluent limitations for Outfall 001 as a result of this permit modification is to increase the daily maximum flow limit from 49,020 gpd to 73,140 gpd and the monthly average flow limit from 27,930 gpd to 73,140 gpd. As demonstrated in the following section, these flow modifications, along with the existing effluent limitations, will continue to meet Alaska water quality criteria at the edge of the existing mixing zone as authorized by the State of Alaska. Therefore, no change is necessary to the end-of-pipe effluent concentrations for biological oxygen demand (5-day) (BOD5), total suspended solids (TSS), total residual chlorine (TRC), fecal coliform, or temperature.

Table 2. Modified Outfall 001 Effluent Limitations					
Parameter	Daily Maximum	Weekly Average	Monthly Average	Units	Modified from existing permit?
BOD	60	45	30	mg/L	No
TSS	60	45	30	mg/L	No
TRC	0.018	NA	0.009	mg/L	No
Fecal Coliform	230	NA	115	FC#/100 ml	No
Temperature	No more than 7EC above or below ambient				No
Flow	73,140	NA	73,140	gpd	Yes
Note: TRC, fecal coliform, temperature, and flow discharge limits apply to Outfall 001 end-of-pipe values. BOD and TSS discharge limits apply to the Outfall 001c discharge pipe prior to commingling of the 001c effluent with 001a and/or 001b.					

III. Basis for Conditions

The original NPDES Fact Sheet (Corps 1999) and the *Northstar Development Unit Mixing Zone Application, Outfalls 001 and 006* (Woodward-Clyde 1997) identified and evaluated the pollutants and chemicals-of-concern associated with each waste stream and associated outfall. Regulatory mixing zones were established and certified for two outfalls (001 and 006) by the State of Alaska, Department of Environmental Conservation (ADEC). ADEC anticipated that a regulatory mixing zone for Outfall 001 was necessary to satisfy state water quality criteria for temperature, pH, and salinity for all reasonably expected effluent and receiving water conditions. The mixing zone approved by ADEC extended 5 meters in horizontal radius from Outfall 001.

The proposed permit modification will not introduce additional chemicals that were not previously evaluated. All pertinent end-of-pipe characteristics of the effluents and their various combinations are listed in Table 3 which is an update of Table 3.1 of the permittee's original mixing zone application. Also tabulated therein are the minimum dilutions necessary to meet Alaska water quality criteria for temperature and salinity, for which the required dilutions range from 1.4 to 7.9. The State authorized a mixing zone for discharges from outfall 001 which extends horizontally from outfall 001 by a 5-meter radius with a minimum dilution ratio of 10.1:1 at the edge of the mixing zone. This ensures that water quality criteria will be met at the edge of the mixing zone for this discharge. Additional detail of the dilution modeling is available in the Appendix to this fact sheet.

TABLE 3.1 (rev.) NORTHSTAR - MIXING ZONE DILUTION REQUIREMENTS - OUTFALL 001

Revised for Two Desalinators			**SUMMER**				**WINTER**
			Stratified		*Unstratified*		*Unstratified*
		Flow	Summer1	Summer2	Summer3	Summer4	
		Rates	Strong	Weak	Low	High	Ice-
		gpd	East Wind	East Wind	Salinity	Salinity	Covered
Ambient Hydrographic Conditions at Seawater Intake (depth = 2.4 m)							
	Temperature (°C.)		0.5	1.8	2	1.8	-1.5
	Salinity (ppt)		19.8	14.2	16.0	30.7	32.4
	Average annual duration (days)		*40*	*60*	*2 (rare)*	*15 - 35*	*250*
Effluent Stream Properties							
001(a)	*Flushwater (continuous)*[1]	21,600					
	Temperature (intake temp. + 1°C.		1.5	2.8	3.0	2.8	-0.5
	Salinity (intake salinity)		19.8	14.2	16.0	30.7	32.4
001(b)	*Brine (intermittent from de-sal. systems)*[2]	37,140					
	Temperature (intake temp. + 7°C.)		7.5	8.8	9.0	8.8	5.5
	Salinity (2 x intake salinity)		39.6	28.4	32.0	61.4	64.8
001(c)	*Wastewater (if injection well inoperable)*[3]	14,400					
	Temperature (18°		18.0	18.0	18.0	18.0	18.0
	Salinity (0.0 ppt)		0.0	0.0	0.0	0.0	0.0
Effluent Stream Combinations							
001(a+b)	*Flushwater + brine*	58,740					
	Temperature (°C.)		5.3	6.6	6.8	6.6	3.3
	Salinity (ppt)		32.3	23.2	26.1	50.1	52.9
	Density (sigma-t)		25.53	18.23	20.49	39.40	42.15
001(a+c)	*Flushwater + wastewater*	36,000					
	Temperature (°C.)		8.1	8.9	9.0	8.9	6.9
	Salinity (ppt)		11.9	8.5	9.6	18.4	19.4
	Density (sigma-t)		9.23	6.51	7.36	14.22	15.22
001(all)	*All flows combined*	73,140					
	Temperature (°C.)		7.8	8.8	9.0	8.8	6.2
	Salinity (ppt)		26.0	18.6	21.0	40.2	42.5
	Density (sigma-t)		20.29	14.39	16.23	31.25	33.47
Ambient Hydrographic Conditions at Outfall 001 (depth = 4.4 m)							
	Temperature (°C.)		0.5	0.0	2.0	1.8	-1.5
	Salinity (ppt)		19.8	30.2	16.0	30.7	32.4
	Density (sigma-t)		15.92	24.26	12.83	24.57	26.09
Minimum Dilution Required to Meet Alaska Water Quality Criteria[4]							
001(a)	*Flushwater only*	21,600	none	none	none	none	none
001(a+b)	*Flushwater + brine*	58,740					
	Temperature		3.8	5.6	3.8	6.1	4.8
	Salinity		2.1	none	1.5	3.9	4.1
001(a+c)	*Flushwater + wastewater*	36,000					
	Temperature		6.6	7.9	6.0	6.1	7.4
	Salinity		none	none	none	none	none
001(all)	*All flows combined*	73,140					
	Temperature		6.3	7.8	6.0	6.0	6.7
	Salinity		none	none	none	1.4	1.5

1Outfall 001 will be flushed with a continuous flow of seawater at 15 gpm. Flush water is drawn from seawater intake at depth of 2.4 m (8 ft).

2Brine from two desalination systems will be discharged with salinity of twice ambient.

3Treated wastewater will be discharged when injection well is inoperable.

4Maximum allowable increases in temperature and salinity, respectively, = 1oC and 4 ppt.

IV. Other Legal Requirements

A. Endangered Species Act and Essential Fish Habitat

Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultation for this project was completed in 1999, prior to issuance of the NPDES permit. This modification to the permit increases outfall 001 flow, however, as demonstrated in this fact sheet, Alaska water quality criteria continue to be met within the previously authorized 5 meter mixing zone. Therefore, EPA has tentatively determined that issuance of this permit modification will have no affect on endangered species or EFH beyond those previously addressed during the 1999 consultation process. EPA will provide the National Marine Fisheries Service and the U.S. Fish and Wildlife Service (the Services) with copies of the draft permit modification and fact sheet during the public notice period. Any comments received from the Services regarding ESA and EFH will be considered prior to issuance of a permit modification.

B. State Certification

Section 401 of the Clean Water Act requires EPA to seek certification from the State that the permit is adequate to meet State water quality standards before issuing a final permit. The regulations allow for the State to stipulate any more stringent condition in the permit, if the certification cites the Clean Water Act or State law provisions upon which that condition is based. In addition, the regulations require a certification to include statements of the extent to which each condition of the permit can be made less stringent without violating the requirements of State law. On August 7, 2000, Alaska DEC issued a draft Certificate of Reasonable Assurance for this permit activity.

C. Permit Expiration

The permit expiration date is not changed by this permit modification. This permit will expire at midnight, June 23, 2004.

V. References

BP Exploration (Alaska), Inc. (BPXA) 1997. Northstar Development NPDES Permit Application. Prepared by Woodward-Clyde Consultants for BP Exploration (Alaska), Inc. October 1, 1997.

U.S. Army Corps of Engineers (Corps) 1999. Final Environmental Impact Statement Beaufort Sea Oil and Gas Development/Northstar Project. 4 volumes + appendices. Prepared by the U.S. Army Corps of Engineers, Alaska District. February 1999.

Woodward-Clyde Consultants (Woodward-Clyde) 1997. Northstar Development Unit Mixing Zone Application, Outfalls 001 and 006. Prepared by Woodward-Clyde Consultants for BP Exploration (Alaska), Inc. December 1997.

Appendix: Dilution Modeling Results

Effects of increasing desalination effluent (Stream 001b) output by installation of an additional desalination unit were investigated by a repetition of the dilution modeling performed for the NPDES permit application. The second desalination unit essentially doubles the maximum daily output of desalination effluent through Outfall 001, increasing this effluent component to a maximum flow of 37,140 gpd. Also incorporated in this round of dilution modeling is the expectation that the sewage treatment system will occasionally operated at its full capacity of 14,400 gpd. No change in flow (21,600 gpd) of the continuous flush system is anticipated.

As before, dilution computations were performed for all three combinations of these effluents for each of ten receiving water conditions: Four summer and one winter (ice-covered) with two current speeds, the higher being the 90^{th} percentile and the lower the 10^{th} percentile of observed currents for the respective seasons. A complete description of receiving water hydrography is contained in both the NPDES permit application (BPXA 1997) and the State of Alaska mixing zone application (Woodward-Clyde 1997).

Results of the dilution modeling are presented as three tables, which are essentially identical in format to Table 3.2 of the mixing zone application. The first, Table 1A, is a reproduction of the results of the initial dilution modeling, except that columns have been added to show the horizontal radial distance (R) from the outfall at which a dilution of 10:1 is achieved. The latter "target" dilution was selected to provide a safety factor beyond the dilutions actually required, all of which were 7.4 or less for the original seawater system configuration.

Table 2A shows the results for the seawater system with a second desalinator in operation, as well as full capacity operation of the sewage treatment system. Presented in the same format as those for the original system, it is apparent that the target dilution of 10:1 is achieved within five meters of the outfall for all cases (i.e. all R(m) < 5 meters).

Table 3A provides a comparison of the two configurations as a tabulation of the differences in the significant effluent parameters (flowrate and density) and the distances to achieve 10:1 dilution. Positive values of the latter indicate that greater distances are required for the new configuration, while negative values indicate lesser distances are required to achieve the target dilution. As already noted, the target dilution is achieved for all cases within the 5-m radius mixing zone.

Effects of changed effluent density and velocity are readily apparent in the dilution modeling results [Table 3A]. Addition of brine from the second desalinator serves to increase effluent density in both combinations where brine is a constituent. The increased wastewater flow (zero salinity) serves to decrease effluent density, although not sufficiently to offset the increase due to the greater amount of brine. In all cases where the density difference between effluent and receiving water is increased, the greater buoyancy flux (both positive and negative) serves to enhance mixing.

However, the increased flowrates of both brine and wastewater actually exert the greater effect on mixing. Near the outfall the effluent discharge is more jet-like and thus more influenced by momentum flux than by buoyancy flux. The dissipation of kinetic energy

along the slipstream of the effluent jet is very effective in achieving mixing quickly, so the target dilution is sometimes achieved more quickly with the greater flowrates than with those of the original configuration. The target dilution is achieved within the authorized 5 meter radius mixing zone, therefore, the changes in the configuration and operation of the seawater treatment system will not affect any aspect of compliance with the NPDES permit for the discharge.

TABLE 1A. NORTHSTAR OUTFALL 001 - DILUTION MODELING RESULTS -

One desalinator (original configuration)

							Location of 10:1 Dilution*							
Effluent	Maximum Flow		Hydro-	Effluent	Ambient	Minimum Current				Maximum Current			
	(gpd)	(m^3/s)	graphic	Density	Density	Winter: 0.5 cm/s; Summer: 3.5				Winter: 6 cm/s; Summer: 42 cm/s			
			Condition	(kg/m^3)	(kg/m^3)	X(m)	Y(m)	*R(m)*	Z(m)	X(m)	Y(m)	*R(m)*	Z(m)
Flushwater	39,660	0.001738	Winter	1037.79	1026.09	0.1	3.4	*3.4*	-0.8	0.8	1.0	*1.3*	-0.5
+ Brine			Summer1	1022.81	1015.92	0.2	2.3	*2.3*	-0.2	3.1	1.1	*3.3*	-0.2
			Summer2	1016.35	1024.26	0.7	1.6	*1.7*	0.6	1.0	0.4	*1.1*	0.1
			Summer3	1018.40	1012.83	0.7	1.4	*1.6*	-0.5	3.5	1.2	*3.7*	-0.2
			Summer4	1035.56	1024.57	0.5	1.0	*1.1*	-0.6	2.5	0.9	*2.7*	-0.3
Flushwater	30,960	0.001356	Winter	1017.94	1026.09	0.1	1.8	*1.8*	0.9	0.8	1.1	*1.4*	0.3
+ Wastewater			Summer1	1010.91	1015.92	0.1	1.7	*1.7*	1.0	1.0	0.3	*1.0*	0.1
			Summer2	1007.70	1024.26	0.9	1.6	*1.8*	1.3	1.2	0.3	*1.2*	0.1
			Summer3	1008.79	1012.83	0.8	1.6	*1.8*	0.4	1.0	0.3	*1.0*	0.1
			Summer4	1016.80	1024.57	0.8	1.6	*1.8*	0.8	1.2	0.3	*1.2*	0.1
Flushwater	49,020	0.002148	Winter	1030.23	1026.09	0.1	2.2	*2.2*	-0.6	0.9	1.6	*1.8*	-0.2
+ Brine			Summer1	1018.22	1015.92	0.1	2.2	*2.2*	-0.3	1.9	0.3	*1.9*	-0.1
+ Wastewater			Summer2	1013.03	1024.26	0.8	2.2	*2.3*	0.5	1.5	0.3	*1.5*	0.1
			Summer3	1014.62	1012.83	0.9	2.3	*2.5*	-0.2	2.0	0.3	*2.0*	-0.1
			Summer4	1028.17	1024.57	0.8	2.0	*2.2*	-0.4	4.8	1.9	*5.2*	-0.2

*Coordinates of position at which 10:1 dilution occurs, relative to outfall, defined as follows:

X = horizontal distance downstream, measured from outfall centerline

Y= distance along horizontal extension of outfall into water column (cross-current)

R= horizontal radial distance from outfall = $(X^2 + Y^2)^{1/2}$

Z=vertical distance above (+) or below (-) outfall centerline

TABLE 2A. NORTHSTAR OUTFALL 001 - DILUTION MODELING RESULTS

Two desalinators and full flow wastewater

							Location of 10:1 Dilution*							
				Hydro-	Effluent	Ambient	Minimum Current				Maximum Current			
Effluent	Maximum Flow			graphic	Density	Density	Winter: 0.5 cm/s; Summer: 3.5 cm/s				Winter: 6 cm/s; Summer: 42 cm/s			
	(gpd)	(m^3/s)		Condition	(kg/m^3)	(kg/m^3)	X(m)	Y(m)	*R(m)*	Z(m)	X(m)	Y(m)	*R(m)*	Z(m)
Flushwater	58,740	0.002583		Winter	1042.15	1026.09	0.1	2	*2.0*	-0.8	0.7	1.2	*1.4*	-0.5
+ Brine				Summer1	1025.53	1015.92	0.5	1.5	*1.6*	-0.5	4.7	1.4	*4.9*	-0.2
				Summer2	1018.23	1024.26	0.7	2.3	*2.4*	0.4	1.2	0.3	*1.2*	0.1
				Summer3	1020.49	1012.83	0.6	1.7	*1.8*	-0.5	3	1.6	*3.4*	-0.2
				Summer4	1039.40	1024.57	0.4	1.3	*1.4*	-0.6	2.3	1.1	*2.5*	-0.3
Flushwater	36,000	0.001583		Winter	1015.22	1026.09	0.1	1.8	*1.8*	0.9	0.8	1.2	*1.4*	0.3
+ Wastewater				Summer1	1009.23	1015.92	0.8	1.8	*2.0*	0.7	1.8	0.2	*1.8*	0
				Summer2	1006.51	1024.26	0.5	1.4	*1.5*	1	1.6	0.2	*1.6*	0.1
				Summer3	1007.36	1012.83	0.8	1.8	*2.0*	0.9	1.1	0.3	*1.1*	0.1
				Summer4	1014.22	1024.57	0.7	1.6	*1.7*	0.8	1.1	0.3	*1.1*	0.1
Flushwater	73,140	0.003217		Winter	1033.47	1026.09	0.1	2.1	*2.1*	-0.8	0.9	2	*2.2*	-0.3
+ Brine				Summer1	1020.29	1015.92	0.6	2.3	*2.4*	-0.2	1.8	0.2	*1.8*	-0.1
+ Wastewater				Summer2	1014.39	1024.26	0.6	2.2	*2.3*	0.4	1.1	0.4	*1.2*	0.1
				Summer3	1016.23	1012.83	0.6	2.3	*2.4*	-0.2	1.1	0.6	*1.3*	-0.1
				Summer4	1031.25	1024.57	0.6	2.3	*2.4*	-0.3	1.2	0.4	*1.3*	-0.1

*Coordinates of position at which 10:1 dilution occurs, relative to outfall, defined as follows:

X = horizontal distance downstream, measured from outfall centerline

Y= distance along horizontal extension of outfall into water column (cross-current)

R= horizontal radial distance from outfall = $(X^2 + Y^2)^{1/2}$

Z=vertical distance above (+) or below (-) outfall centerline

TABLE 3A. NORTHSTAR OUTFALL 001 - DILUTION MODELING RESULTS

DIFFERENCE TABLE - Data and results for two desalinators less same for single desalinator

					Changes in		Change in Location of 10:1 Dilution*							
	Change in			Hydro-	Effluent	Ambient	Minimum Current				Maximum Current			
Effluent	Maximum Flow			graphic	Density	Density	Winter: 0.5 cm/s; Summer: 3.5 cm/s				Winter: 6 cm/s; Summer: 42 cm/s			
	(gpd)	(m^3/s)	*Pct.*	Condition	(kg/m^3)	(kg/m^3)	X(m)	Y(m)	*R(m)*	Z(m)	X(m)	Y(m)	*R(m)*	Z(m)
Flushwater	19,080	0.000846	*48.1*	Winter	4.36	0.00	0.0	-1.4	*-1.4*	0.0	-0.1	0.2	*0.1*	0.0
+ Brine				Summer1	2.72	0.00	0.3	-0.8	*-0.7*	-0.3	1.6	0.3	*1.6*	0.0
				Summer2	1.88	0.00	0.0	0.7	*0.7*	-0.2	0.2	-0.1	*0.2*	0.0
				Summer3	2.09	0.00	-0.1	0.3	*0.2*	0.0	-0.5	0.4	*-0.3*	0.0
				Summer4	3.84	0.00	-0.1	0.3	*0.2*	0.0	-0.2	0.2	*-0.1*	0.0
Flushwater	5,040	0.000227	*16.3*	Winter	-2.72	0.00	0.0	0.0	*0.0*	0.0	0.0	0.1	*0.1*	0.0
+ Wastewater				Summer1	-1.68	0.00	0.7	0.1	*0.3*	-0.3	0.8	-0.1	*0.8*	-0.1
				Summer2	-1.19	0.00	-0.4	-0.2	*-0.3*	-0.3	0.4	-0.1	*0.4*	0.0
				Summer3	-1.43	0.00	0.0	0.2	*0.2*	0.5	0.1	0.0	*0.1*	0.0
				Summer4	-2.58	0.00	-0.1	0.0	*-0.0*	0.0	-0.1	0.0	*-0.1*	0.0
Flushwater	24,120	0.001069	*49.2*	Winter	3.24	0.00	0.0	-0.1	*-0.1*	-0.2	0.0	0.4	*0.4*	-0.1
+ Brine				Summer1	2.07	0.00	0.5	0.1	*0.2*	0.1	-0.1	-0.1	*-0.1*	0.0
+ Wastewater				Summer2	1.36	0.00	-0.2	0.0	*-0.1*	-0.1	-0.4	0.1	*-0.4*	0.0
				Summer3	1.61	0.00	-0.3	0.0	*-0.1*	0.0	-0.9	0.3	*-0.8*	0.0
				Summer4	3.08	0.00	-0.2	0.3	*0.2*	0.1	-3.6	-1.5	*-3.9*	0.1
*Coordinates of position at which 10:1 dilution occurs, relative to outfall, defined as follows:														
	X = horizontal distance downstream, measured from outfall centerline													
	Y= distance along horizontal extension of outfall into water column (cross-current)													
	R= horizontal radial distance from outfall = $(X^2 + Y^2)^{½}$													
	Z=vertical distance above (+) or below (-) outfall centerline													